



STGP14NC60KD - STGF14NC60KD STGB14NC60KD

N-CHANNEL 14A - 600V - TO-220/TO-220FP/D²PAK
SHORT CIRCUIT RATED PowerMESH™ IGBT

Table 1: General Features

TYPE	V _{CES}	V _{CE(sat)} (Max) @25°C	I _C (#) @100°C
STGB14NC60KD	600 V	< 2.5 V	14 A
STGF14NC60KD	600 V	< 2.5 V	7 A
STGP14NC60KD	600 V	< 2.5 V	14 A

- LOWER ON-VOLTAGE DROP (V_{cesat})
- OFF LOSSES INCLUDE TAIL CURRENT
- LOWER C_{RES} / C_{IES} RATIO
- SWITCHING LOSSES INCLUDE DIODE RECOVERY ENERGY
- VERY SOFT ULTRA FAST RECOVERY ANTIPARALLEL DIODE
- NEW GENERATION PRODUCTS WITH TIGHTER PARAMETER DISTRUBUTION

DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "K" identifies a family optimized for high frequency motor control applications with short circuit withstand capability.

APPLICATIONS

- HIGH FREQUENCY INVERTERS
- SMPS and PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES
- MOTOR DRIVERS

Figure 1: Package

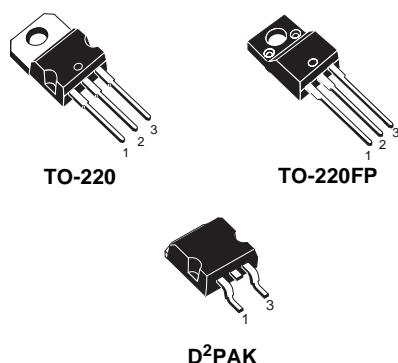


Figure 2: Internal Schematic Diagram

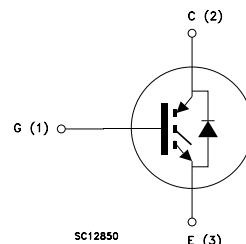


Table 2: Order Codes

SALES TYPE	MARKING	PACKAGE	PACKAGING
STGB14NC60KD4	GB14NC60KD	D ² PAK	TAPE & REEL
STGF14NC60KD	GF14NC60KD	TO-220FP	TUBE
STGP14NC60KD	GP14NC60KD	TO-220	TUBE

Table 3: Absolute Maximum ratings

Symbol	Parameter	Value		Unit
		STGB14NC60KD STGP14NC60KD	STGF14NC60KD	
V _{CES}	Collector-Emitter Voltage (V _{GS} = 0)	600		V
V _{ECR}	Emitter-Collector Voltage	20		V
V _{GE}	Gate-Emitter Voltage	±20		V
I _C	Collector Current (continuous) at T _C = 25°C (#)	25	11	A
I _C	Collector Current (continuous) at T _C = 100°C (#)	14	7	A
I _{CM} (#)	Collector Current (pulsed)	50		A
I _F	Diode RMS Forward Current at T _C = 25°C	20		A
P _{TOT}	Total Dissipation at T _C = 25°C	80	25	W
	Derating Factor	0.64	0.20	W/°C
V _{ISO}	Insulation Withstand Voltage A.C.(t = 1 sec; T _C = 25°C)	--	2500	V
T _{stg}	Storage Temperature	– 55 to 150		
T _j	Operating Junction Temperature	– 55 to 150		

(*) Pulse width limited by Max Junction Temperature.

Table 4: Thermal Data

			Min.	Typ.	Max.	
R _{thj-case}	Thermal Resistance Junction-case	TO-220 D ² PAK			1.56	°C/W
		TO-220FP			5.0	°C/W
R _{thj-amb}	Thermal Resistance Junction-ambient				62.5	°C/W
T _L	Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.)			300		°C

ELECTRICAL CHARACTERISTICS (T_{CASE} =25°C UNLESS OTHERWISE SPECIFIED)**Table 5: Main Parameters**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{BR(CES)}	Collector-Emitter Breakdown Voltage	I _C = 1 mA, V _{GE} = 0	600			V
I _{CES}	Collector cut-off Current (V _{GE} = 0)	V _{CE} = Max Rating, T _C = 25°C V _{CE} = Max Rating, T _C = 125°C			10 1	µA mA
I _{GES}	Gate-Emitter Leakage Current (V _{CE} = 0)	V _{GE} = ±20V , V _{CE} = 0			±100	nA
V _{GE(th)}	Gate Threshold Voltage	V _{CE} = V _{GE} , I _C = 250 µA	5		7	V
V _{CE(sat)}	Collector-Emitter Saturation Voltage	V _{GE} = 15V, I _C = 7A V _{GE} = 15V, I _C = 7A, T _C = 125°C		2.0 1.8	2.5	V V

(#) Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

ELECTRICAL CHARACTERISTICS (CONTINUED)**Table 6: Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	$V_{CE} = 15 \text{ V}$, $I_C = 7 \text{ A}$		3		S
C_{ies}	Input Capacitance	$V_{CE} = 25 \text{ V}$, $f = 1 \text{ MHz}$, $V_{GE} = 0$		760		pF
C_{oes}	Output Capacitance			86		pF
C_{res}	Reverse Transfer Capacitance			15.5		pF
Q_g	Total Gate Charge	$V_{CE} = 390 \text{ V}$, $I_C = 7 \text{ A}$,		34.4		nC
Q_{ge}	Gate-Emitter Charge	$V_{GE} = 15 \text{ V}$		8.1		nC
Q_{gc}	Gate-Collector Charge	(see Figure 21)		16.4		nC
t_{scw}	Short Circuit Withstand Time	$V_{CE} = 0.5 \text{ V}_{BR(CES)}$, $T_j = 125^\circ\text{C}$, $R_G = 10 \Omega$, $V_{GE} = 12 \text{ V}$	10			μs

Table 7: Switching On

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_d(on)$	Turn-on Delay Time	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$		22.5		ns
t_r (di/dt) _{on}	Current Rise Time	$R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_j = 25^\circ\text{C}$		8.5		ns
	Turn-on Current Slope	(see Figure 19)		700		A/ μs
$t_d(on)$	Turn-on Delay Time	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$		22		ns
t_r (di/dt) _{on}	Current Rise Time	$R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_j = 125^\circ\text{C}$		9.5		ns
	Turn-on Current Slope	(see Figure 19)		680		A/ μs

Table 8: Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_r(V_{off})$	Off Voltage Rise Time	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$,		60		ns
$t_d(off)$	Turn-off Delay Time	$R_{GE} = 10 \Omega$, $V_{GE} = 15 \text{ V}$		116		ns
t_f	Current Fall Time	$T_j = 25^\circ\text{C}$		75		ns
		(see Figure 19)				
$t_r(V_{off})$	Off Voltage Rise Time	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$,		24		ns
$t_d(off)$	Turn-off Delay Time	$R_{GE} = 10 \Omega$, $V_{GE} = 15 \text{ V}$		196		ns
t_f	Current Fall Time	$T_j = 125^\circ\text{C}$		144		ns
		(see Figure 19)				

Table 9: Switching Energy

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$E_{on}(2)$	Turn-on Switching Losses	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$		82		μJ
$E_{off}(3)$	Turn-off Switching Losses	$R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_j = 25^\circ\text{C}$		155		μJ
E_{ts}	Total Switching Losses	(see Figure 19)		237		μJ
$E_{on}(2)$	Turn-on Switching Losses	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$		131		μJ
$E_{off}(3)$	Turn-off Switching Losses	$R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_j = 125^\circ\text{C}$		370		μJ
E_{ts}	Total Switching Losses	(see Figure 19)		501		μJ

(1) Pulsed: Pulse duration = 300 μs , duty cycle 1.5%

(2) Eon is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs & DIODE are at the same temperature (25°C and 125°C)

(3) Turn-off losses include also the tail of the collector current.

Table 10: Collector-Emitter Diode

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_f	Forward On-Voltage	$I_f = 3.5 \text{ A}$ $I_f = 3.5 \text{ A}, T_j = 125 \text{ }^\circ\text{C}$		1.3 1.1	1.9	V V
t_{rr} t_a Q_{rr} I_{rrm} S	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current Softness factor of the diode	$I_f = 7 \text{ A}, V_R = 40 \text{ V},$ $T_j = 25 \text{ }^\circ\text{C}, di/dt = 100 \text{ A}/\mu\text{s}$		37 22 40 2.1 0.68		ns ns nC A
t_{rr} t_a Q_{rr} I_{rrm} S	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current Softness factor of the diode	$I_f = 7 \text{ A}, V_R = 40 \text{ V},$ $T_j = 125 \text{ }^\circ\text{C}, di/dt = 100 \text{ A}/\mu\text{s}$		61 34 98 3.2 0.79		ns ns nC A

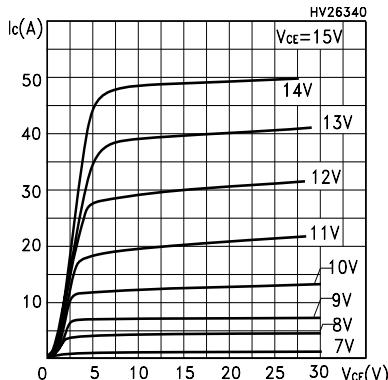
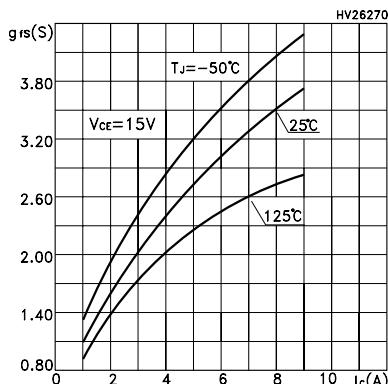
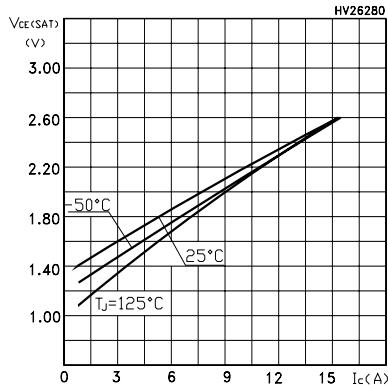
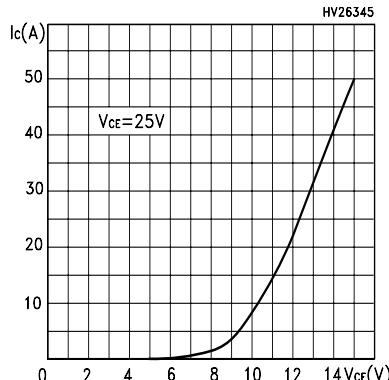
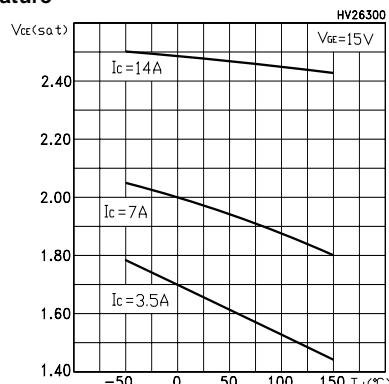
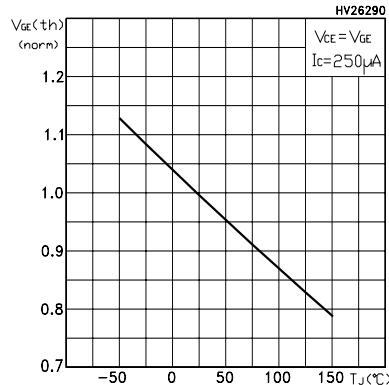
Figure 3: Output Characteristics**Figure 4: Transconductance****Figure 5: Collector-Emitter On Voltage vs Collector Current****Figure 6: Transfer Characteristics****Figure 7: Collector-Emitter On Voltage vs Temperature****Figure 8: Normalized Gate Threshold vs Temperature**

Figure 9: Normalized Breakdown Voltage vs Temperature

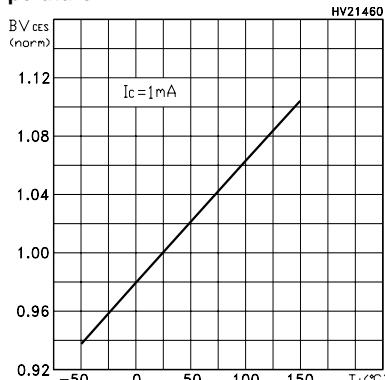


Figure 10: Capacitance Variations

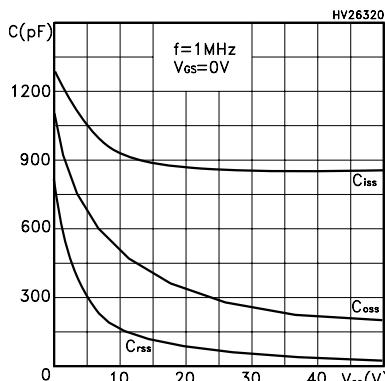


Figure 11: Total Switching Losses vs Gate Resistance

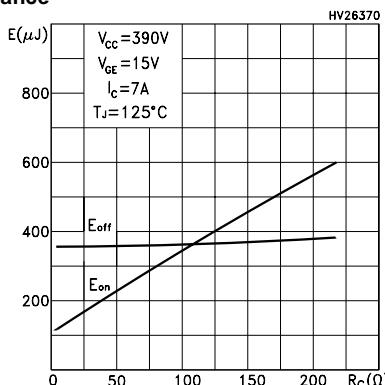


Figure 12: Gate Charge vs Gate-Emitter Voltage

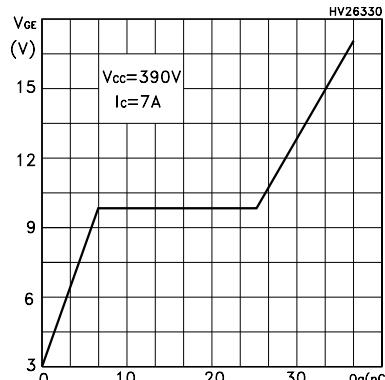


Figure 13: Total Switching Losses vs Temperature

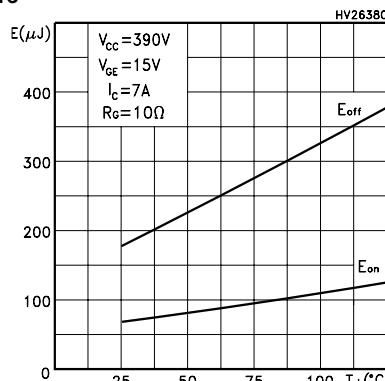


Figure 14: Total Switching Losses vs Collector Current

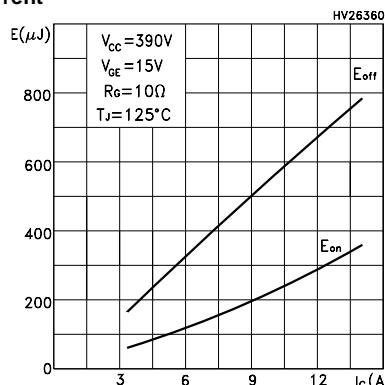


Figure 15: Thermal Impedance For TO-220/D²PAK

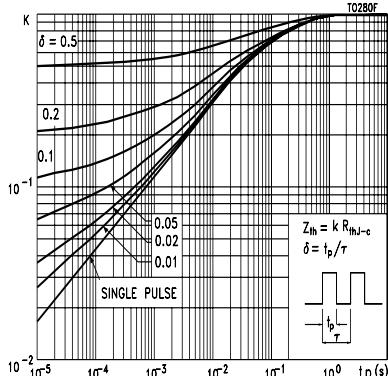


Figure 16: Thermal Impedance For TO-220FP

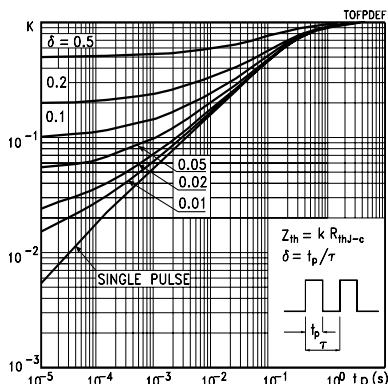


Figure 17: Turn-Off SOA

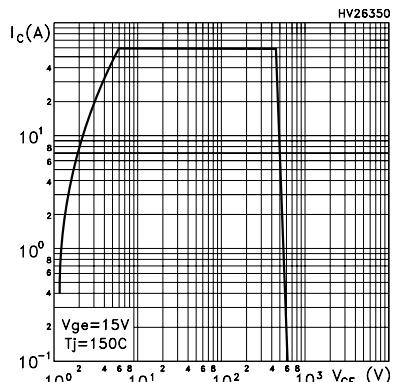


Figure 18: Emitter-Collector Diode Characteristics

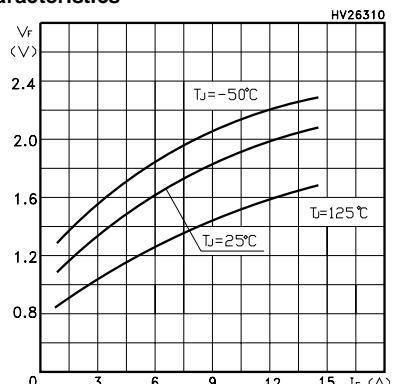


Figure 19: Test Circuit for Inductive Load Switching

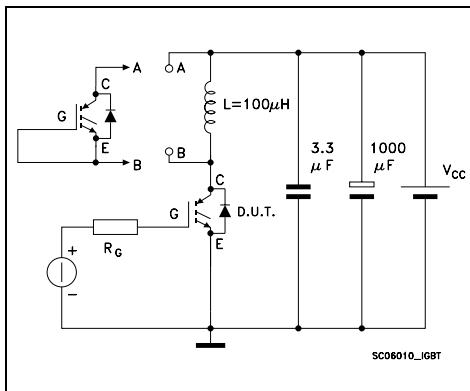


Figure 20: Switching Waveforms

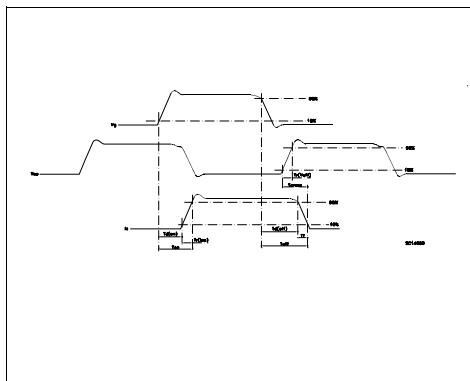


Figure 21: Gate Charge Test Circuit

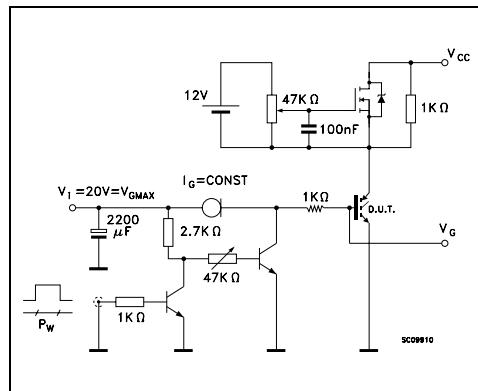
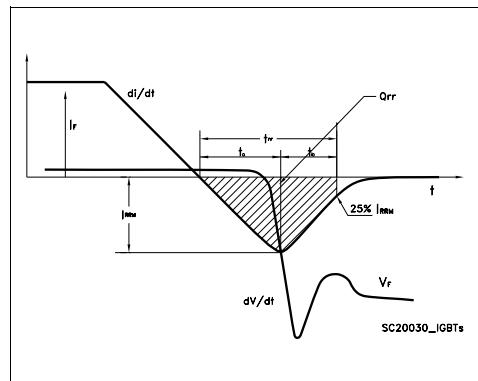
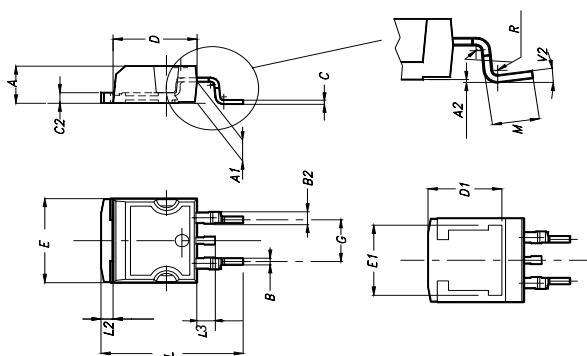


Figure 22: Diode Recovery Times Waveform



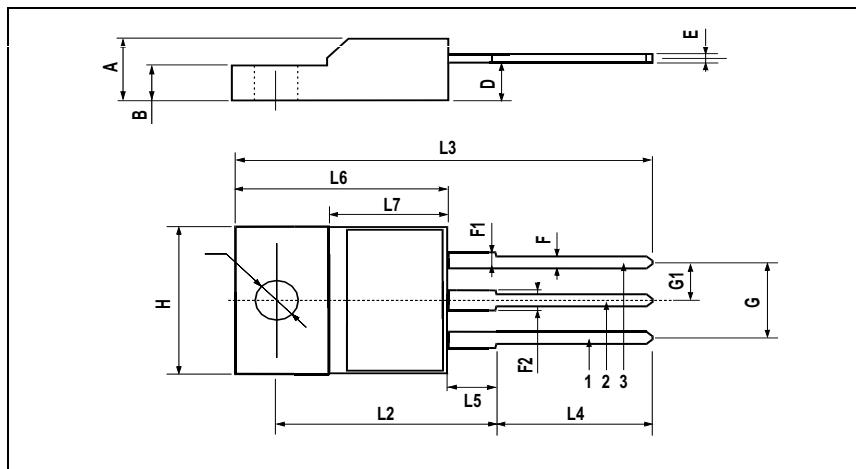
D²PAK MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			



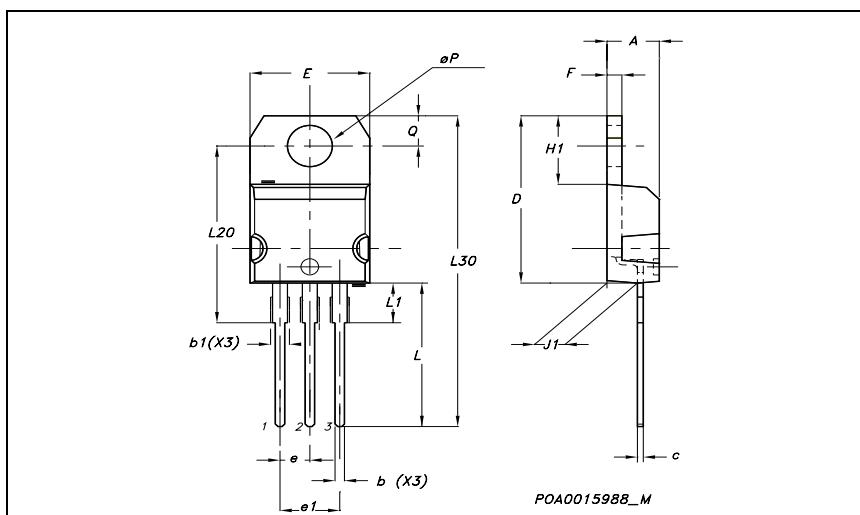
TO-220FP MECHANICAL DATA

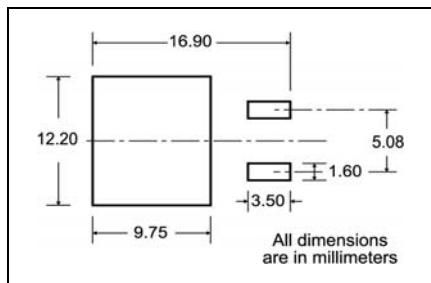
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126



TO-220 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
ϕP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



D²PAK FOOTPRINT**TAPE AND REEL SHIPMENT**

TAPE MECHANICAL DATA					REEL MECHANICAL DATA				
DIM.	mm		inch		DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.		MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421	A	330		12.992	
B0	15.7	15.9	0.618	0.626	B	1.5		0.059	
D	1.5	1.6	0.059	0.063	C	12.8	13.2	0.504	0.520
D1	1.59	1.61	0.062	0.063	D	20.2		0.795	
E	1.65	1.85	0.065	0.073	G	24.4	26.4	0.960	1.039
F	11.4	11.6	0.449	0.456	N	100		3.937	
K0	4.8	5.0	0.189	0.197	T		30.4		1.197
P0	3.9	4.1	0.153	0.161					
P1	11.9	12.1	0.468	0.476					
P2	1.9	2.1	0.075	0.082					
R	50		1.574						
T	0.25	0.35	0.0098	0.0137					
W	23.7	24.3	0.933	0.956					

TAPE MECHANICAL DATA

40 mm min. Access hole at slot location
Full radius
Tape slot in core for tape start 2.5mm min. width

REEL MECHANICAL DATA

Dimensions: A=16.90 mm, B=1.5 mm, C=12.8 mm, D=20.2 mm, G=24.4 mm, N=100 mm, T=30.4 mm

BASE QTY **BULK QTY**

1000 1000

TRL **FEED DIRECTION** **User Direction of Feed**

Bending radius R min.

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

* on sales type

Table 11: Revision History

Date	Revision	Description of Changes
14-Jun-2005	1	New release
22-Jul-2005	2	Complete version

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